PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2004P00018WO	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. PCT/EP2004/014570	International filing date *(day/month/year)* 22.12.2004	Priority date *(day/month/year)* 02.03.2004
International Patent Classification (IPC) or national classification and IPC G01P15/08, G01P15/12, G01L1/22		
Applicant ETH ZÜRICH et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 2 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand 29.09.2005	Date of completion of this report 17.02.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Trique, M Telephone No. +49 89 2399-6252

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/014570

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-9 as originally filed

Claims, Numbers

1-10 as amended (together with any statement) under Art. 19 PCT

Drawings, Sheets

1/2, 2/2 as originally filed

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4,5,7-10
	No:	Claims	1-3,6
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-10
Industrial applicability (IA)	Yes:	Claims	1-10
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

RE ITEM V
REASONED STATEMENT UNDER ART. 35 (2) PCT WITH REGARD TO NOVELTY AND INVENTIVE STEP

1. *TECHNICAL FIELD*

The invention disclosed in claims 1 to 10 relates to a force sensor comprising a nanostructure.

2. STATE OF THE ART

The following documents are referred to in the present report:

D1: US-A-2002/0167374

D2: "Reversible electromechanical characteristics of carbon nanotubes under local-probe manipulation" by Tombler et al.

3. NOVELTY - ART. 33(2) PCT

The present application does not meet the requirements of Art. 33(1) PCT, because the subject-matter of the **independent claim 1** is not new (Art. 33(2) PCT).

3.1 *Independent apparatus claim 1*

D2 (see in particular p.769-771), discloses:

a force sensor (see p.769, c.2, l.11-18 and Fig. 2) including a support of two arms (see Fig. 1) carrying a longitudinal electromechanical nanostructure ("nanotube suspension"), which electric properties are changeable by a mechanical deformation due to a force (see p.769, c.2, l.3-10; c.770; c.2, l.5- p.771, l.20 and Fig. 3), said force sensor further comprising an actuator ("AFM tip") to transmit a force to said nanostructure.

All the technical features of claim 1 are known from **D2**. Consequently, the subject-matter of **claim 2** is not new.

3.2 *Dependent claims 2, 3 and 6*

The subject-matter of the dependent claims 2, 3 and 6 is also anticipated by **D2**:

- **claim 2:** see **D2**, abstract.
- **claim 3:** see **D2**, p.769, l.3-4 and Fig. 3.

- **claim 6:** see **D2** (Fig. 1c).

4. The subject-matter of the **dependent claims 4, 5 and 7 to 10** does not involve an inventive step (Art. 33(3) PCT), since it involves matter of normal design procedure in the field of force sensors:
   - **claim 4:** the U-shape of the support does not provide any non-obvious advantage to the claimed force sensor.
   - **claim 5:** see the force sensor of **D1**, [0040], [0041], [0043]; Fig. 1, 3 and 12.
   - **claims 7 to 10:** it is known from the skilled person to use a separate reference sensor to compensate for external environmental effects. This procedure is not specific to the use of nanostructures. Consequently, the subject-matter of claims 7 to 10 is regarded as being within the scope of the customary practice followed by persons skilled in the art.

PCT/EP2004/014570

R'vcd on EP0414570

30 IR

Claims

1. Force sensor (1) including a support (2) of two arms carrying an longitudinal electromechanical element (3), which electric properties are changeable by a mechanical deformation (Δx) due to a force (F);
characterised in that
the electromechanical element is a nanostructure (3) and an actuator is provided in order to transmit a force (F) to the nanostructure (3).

2. Force sensor (1) according to claim 1;
characterised in that
the nanostructure (3) is either a nanotube or a carbon nanotube or bor-nitride nanotubes or a quasi one-dimensional (1D) nanostructure.

3. Force sensor (1) according to claim 1 or 2;
characterised in that
the changeable electric property is the conductance.

4. Force sensor (1) according to anyone of the claims 1 to 3;
characterised in that
the support (2) is U-shaped.

5. Force sensor (1) according to anyone of the claims 1 to 4;
characterised in that
each arm (2) is provided with a cusp (5), on which the nanostructure (3) is mounted.

AMENDED SHEET (ARTICLE 19)

AMENDED SHEET (ARTICLE 19)

6. Force sensor (1) according to anyone of the claims 1 to 5;
characterised in that
a movable mass (7, m) provided with a tip (11) is arranged between the arms (4), where the mass (7) is movable due to an acting acceleration (a) and due to the resulting force (F) the tip (11) acts on the nanostructure (3).

7. Force sensor (1) according to anyone of the claims 1 to 6;
characterised in that
a second nanostructure (10) is carried by the arms (4) in order to compensate environmental effects.

8. Force sensor (1) according to claim 7;
characterised in that
each arm (2) is provided with a further cusp (5), on which the second nanostructure (10) is mounted.

9. Force sensor (1) according to claim 8;
characterised in that
each arm (2) is provided with an insulation (9) in order to electrically separate the nanostructure (3, 10).

10. Force sensor (1) according to anyone of the claims 7 to 9;
characterised in that
the second nanostructure (10) is either a nanotube or a carbon nanotube or a quasi one-dimensional nanostructure.

AMENDED SHEET (ARTICLE 19)